<u>Semiparametric Bayesian testing in large model spaces</u>

James Scott, University of Texas McCombs School of Business

Abstract:

This talk describes two related statistical problems, organized around the general principle of hypothesis testing within semiparametric models.

First, I describe a new method for testing whether a function is monotone. There is a modestly large classical literature on this topic, but surprising little from a Bayesian perspective. I construct a family of continuously differentiable stochastic processes parametrized by a turning point --- that is, an element of the state space where the process's first derivative changes sign --- and show how this can be used in a nonparametric test for monotonicity under a wide class of sampling models (including Gaussian, logit, and over-dispersed Poisson). I also describe a new theoretical framework for studying the asymptotic properties of Bayes factors that arise in nonparametric testing problems. This provides a simple proof of the consistency of the proposed test. Additionally, our empirical study suggests that, compared to existing frequentist tests, the method has higher power for a fixed size. This is joint work with Tom Shively and Stephen Walker.

Second, I consider the multiple-testing problem as it arises in network inference. The goal is to learn the connectivity structure of a network on the basis of pairwise statistics that measure conditional independence between nodes. A semiparametric Bayesian model is presented that allows edge-level covariates to affect the likelihood of an edge's inclusion. Our motivating example arises in neuroscience, where the network encodes a pattern of functional relationships among neurons. Further extensions to inference about disease networks arising from electronic health-record databases are briefly considered. This is joint work with Rob Kass, Matthew Smith, Ryan Kelly, and Matthew Cowperthwaite.